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INTERFERENCE FROM SATURN V PROTOTYPE INTERNAL WORK LIGHTS

RF SYSTEMS BRANCH
TELEMETRIC SYSTEMS DIVISION

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INTERFERENCE FROM SATURN V PROTOTYPE INTERNAL WORK LIGHTS

ABSTRACT

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This report contains an evaluation of Saturn V prototype internal work lamps when tested for broadband radiated and broadband conducted interference. Test configurations, test results, conclusions, and recommendations are included.

author

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TR-221

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SECTION I
INTRODUCTION

A. PURPOSE

This report shows the level of broadband radiated and broadband conducted interference of Saturn V prototype internal work lamps. The tests were conducted to determine compliance of test specimens to the requirements of Military Specification MIL-I-6181D, Interference Control Requirements, Aircraft Equipment, dated 25 November 1959; and to investigate and recommend suppressive techniques, if required.

B. SCOPE

This report describes the tests conducted, test results, and appropriate conclusions and recommendations. Photographs of test equipment and graphs of test results are included.

C. DEFINITION OF INTERFERENCE

For the purpose of this report, interference is defined as any electrical or electromagnetic disturbance, phenomenon, signal or emission, man-made or natural, which causes or can cause undesired response malfunction, or degradation of performance of electrical or electronic equipment.

D. ABBREVIATIONS

ac	alternating current
db	decibel(s)
Gc	gigacycles per second
kc	kilocycles per second
Mc	megacycles per second

SECTION II
TEST PROCEDURES AND RESULTS

Broadband radiated and conducted interference tests were performed on the test specimens in accordance with Military Specification MIL-I-6181D. The tests were conducted in a radio frequency shielded enclosure in the Central Instrumentation Facility (CIF), John F. Kennedy Space Center, Florida.

A. TEST SPECIMEN

Test specimens were three Saturn V prototype internal-work lamps utilizing General Electric (GE) fluorescent bulbs, model F20T12-CW.

B. TEST EQUIPMENT

The following equipment was used to conduct the various tests:

1. One Empire Device noise and field intensity meter, model NF-105/FX, which includes:

   a. Tuning unit, model TA/NF-105FX (frequency range: 0.15 Mc to 30 Mc)

   b. Tuning unit, model T-1/NF-105FX (frequency range: 20 Mc to 200 Mc)

   c. Tuning unit, model T-2/NF-105FX (frequency range: 200 Mc to 400 Mc)

   d. Tuning unit, model T-3/NF-105FX (frequency range: 400 Mc to 1 Gc)

2. One Empire Device 41-inch vertical antenna, model VA 105 (frequency range: 0.15 Mc to 30 Mc)

3. One Empire Device dipole antenna, model DM 205-T1 (frequency range: 20 Mc to 200 Mc)

4. One Empire Device dipole antenna, model DM 205-T2 (frequency range: 200 Mc to 400 Mc)

5. One Empire Device dipole antenna, model DM 205-T3 (frequency range: 400 Mc to 1 Gc)

6. Two Sprague line stabilization networks (serial numbers 140 and 141)

7. Two 50-ohm terminations

C. BROADBAND RADIATED INTERFERENCE TESTS (150 KC to 1 GC)

Broadband radiated interference tests were performed in accordance with Military Specification MIL-I-6181D which specifies antenna orientations and adjustments from 150 kc to 1 Gc.

1. Test Procedures. Tests were performed individually on three test specimens (fluorescent work lamps) and with all three test specimens connected in parallel and operating simultaneously.

In addition to the routine tests, additional tests were conducted on specimen C to determine shielding effectiveness. Specimen C was shielded with a fine-mesh copper screen for one test, and with three welding rods equally spaced and running length-wise along the outside of the work lamp for the other test. The rods were electrically and mechanically attached to the metal end plate of the lamp.

Figures 1, 2, and 3 illustrate typical test configurations used for measuring levels of broadband radiated interference.

2. Test Results. The measured level of broadband radiated interference from each of the unshielded specimens exceeded the limits of Military Specification MIL-I-6181D when operated individually or collectively. Maximum deviations above allowable limits were as follows:

Specimen	Level in db	Frequency in kc
A	41	150
B	30	350
C	47	350 and 600
A, B, and C	49	400

With the copper screen shield in place, the broadband radiated interference level was reduced to essentially the ambient level in the shielded room. The configuration shielded by the three welding rods provided adequate attenuation above 300 kc.

The measured levels of broadband radiated interference are presented graphically in figures 4 through 8.

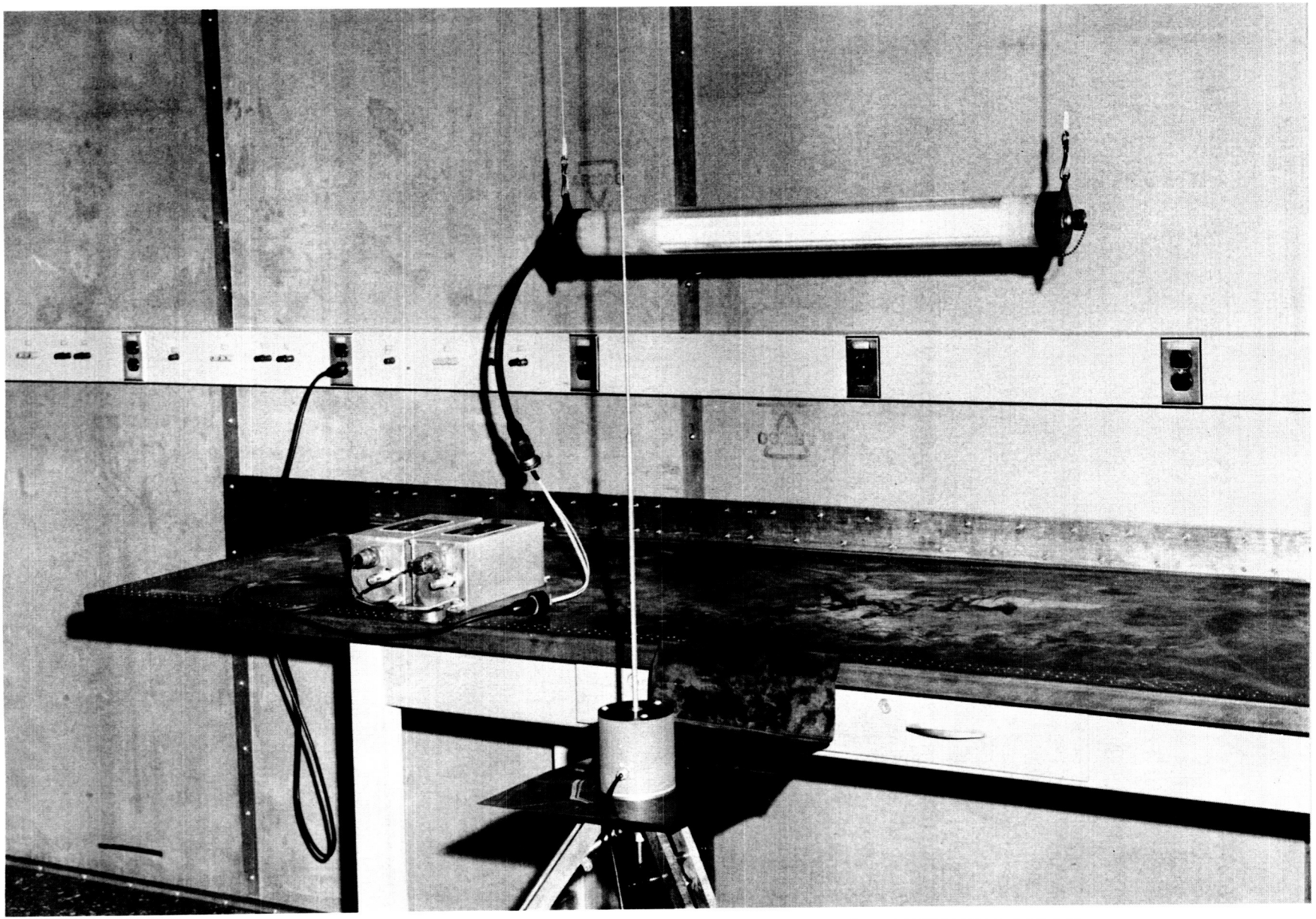

FIGURE 1. BROADBAND RADIATED INTERFERENCE TEST CONFIGURATION
(FREQUENCY RANGE: 150KC to 20MC)

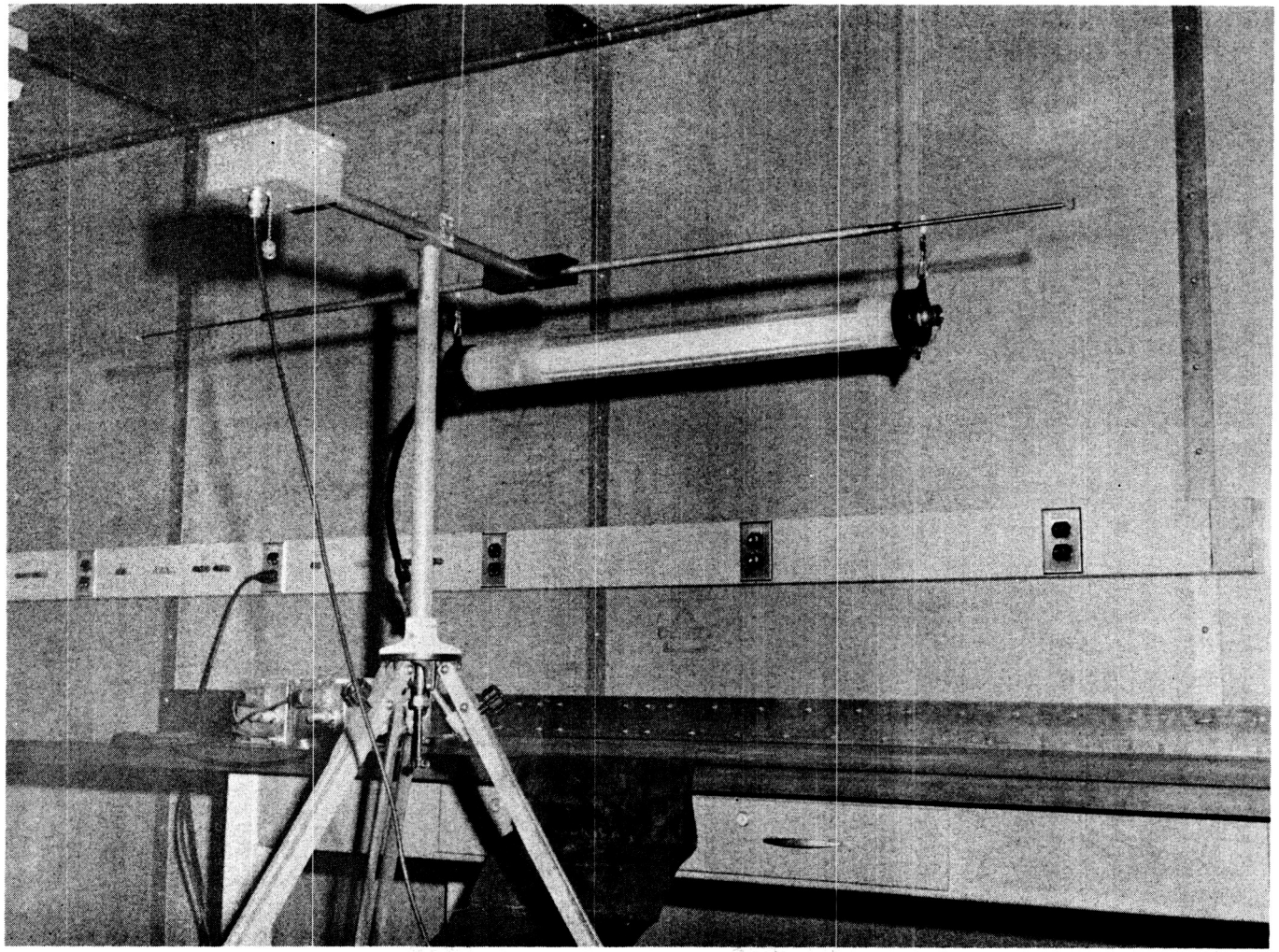

FIGURE 2. BROADBAND RADIATED INTERFERENCE TEST CONFIGURATION
(FREQUENCY RANGE: 20MC to 1GC)

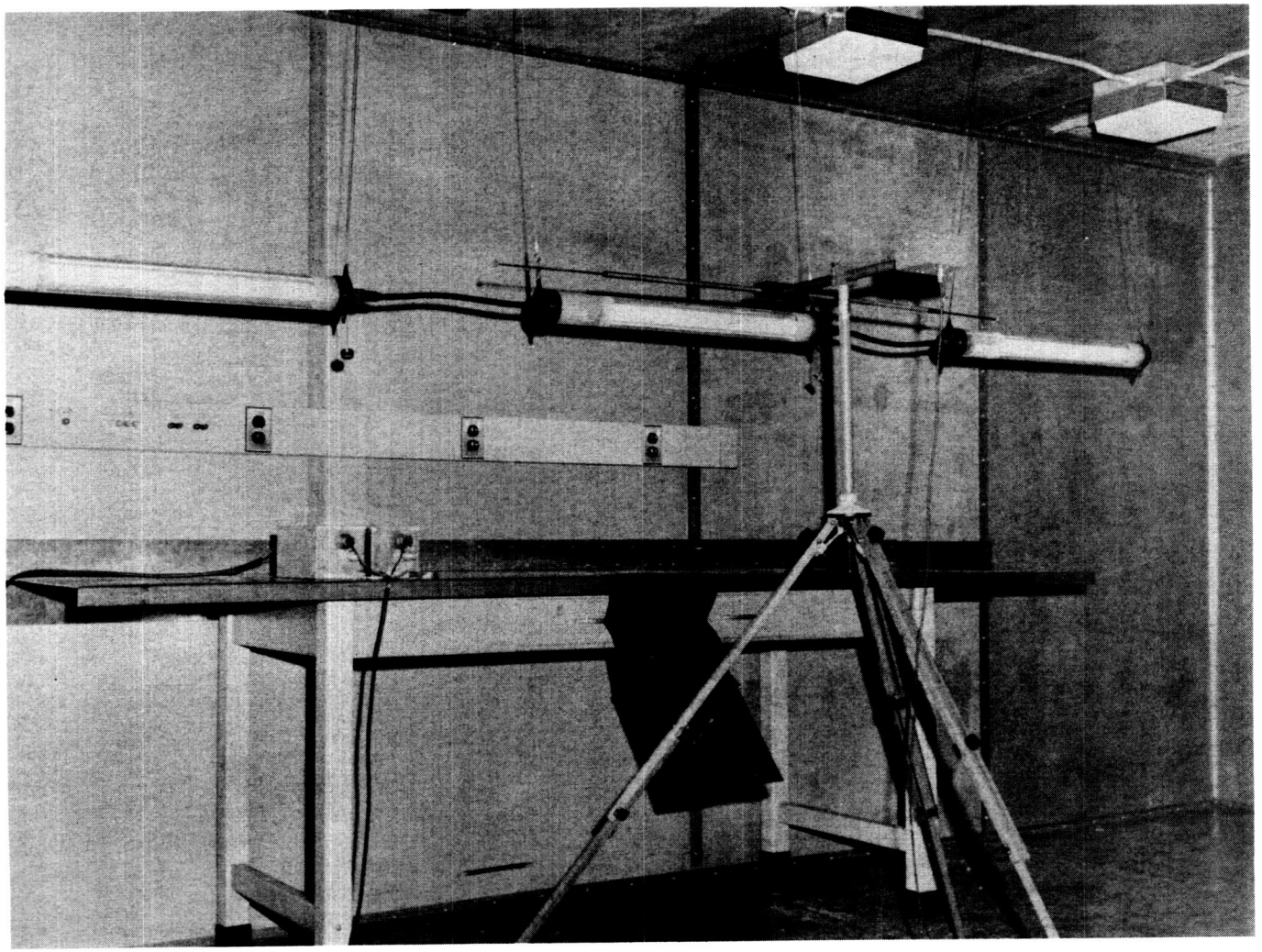

FIGURE 3. BROADBAND RADIATED INTERFERENCE TEST CONFIGURATION (3 SPECIMENS CONNECTED IN PARALLEL, FREQUENCY RANGE: 20MC to 1GC)

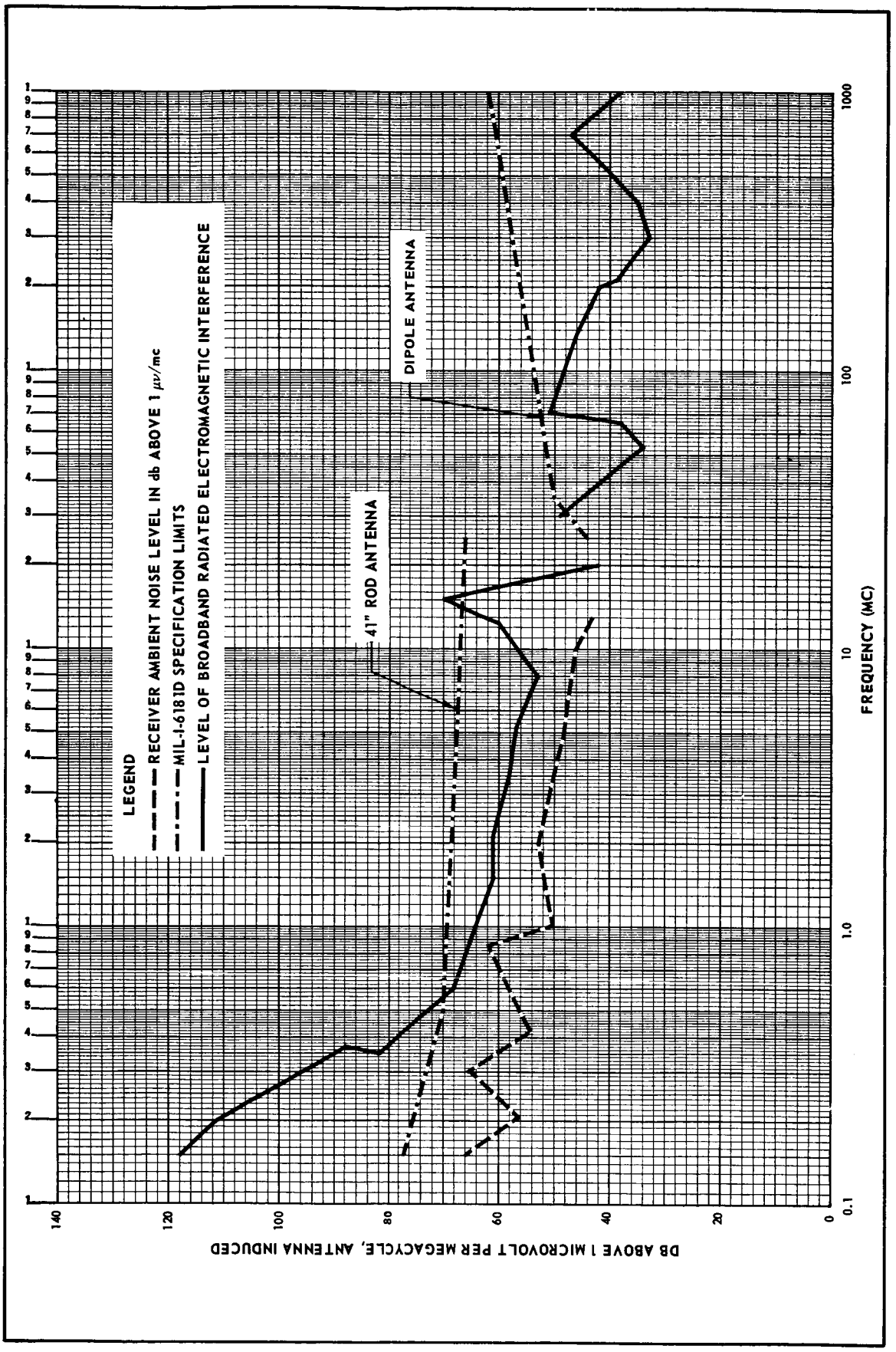

FIGURE 4. BROADBAND RADIATED INTERFERENCE TEST RESULTS (SPECIMEN A)

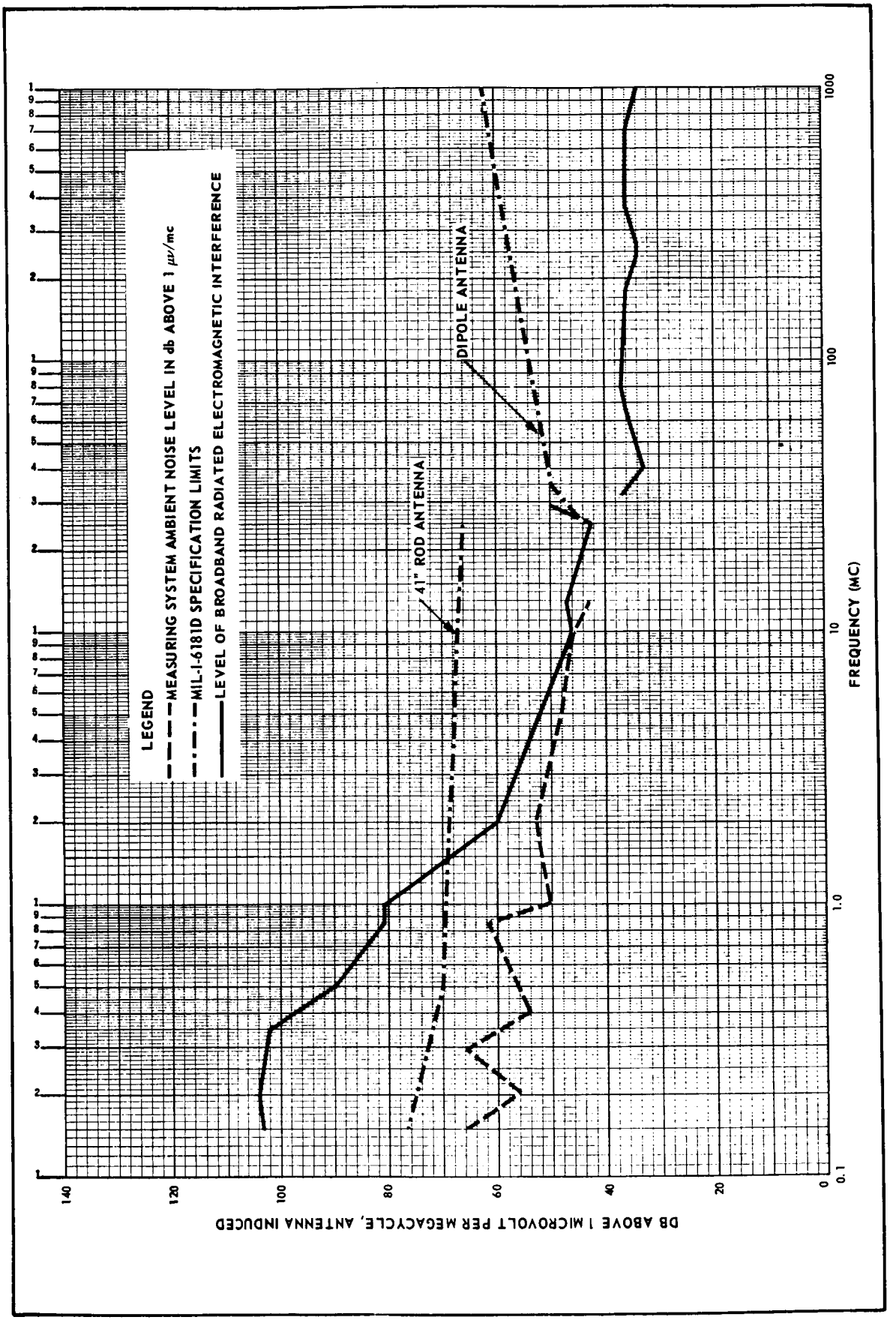

FIGURE 5. BROADBAND RADIATED INTERFERENCE TEST RESULTS (SPECIMEN B)

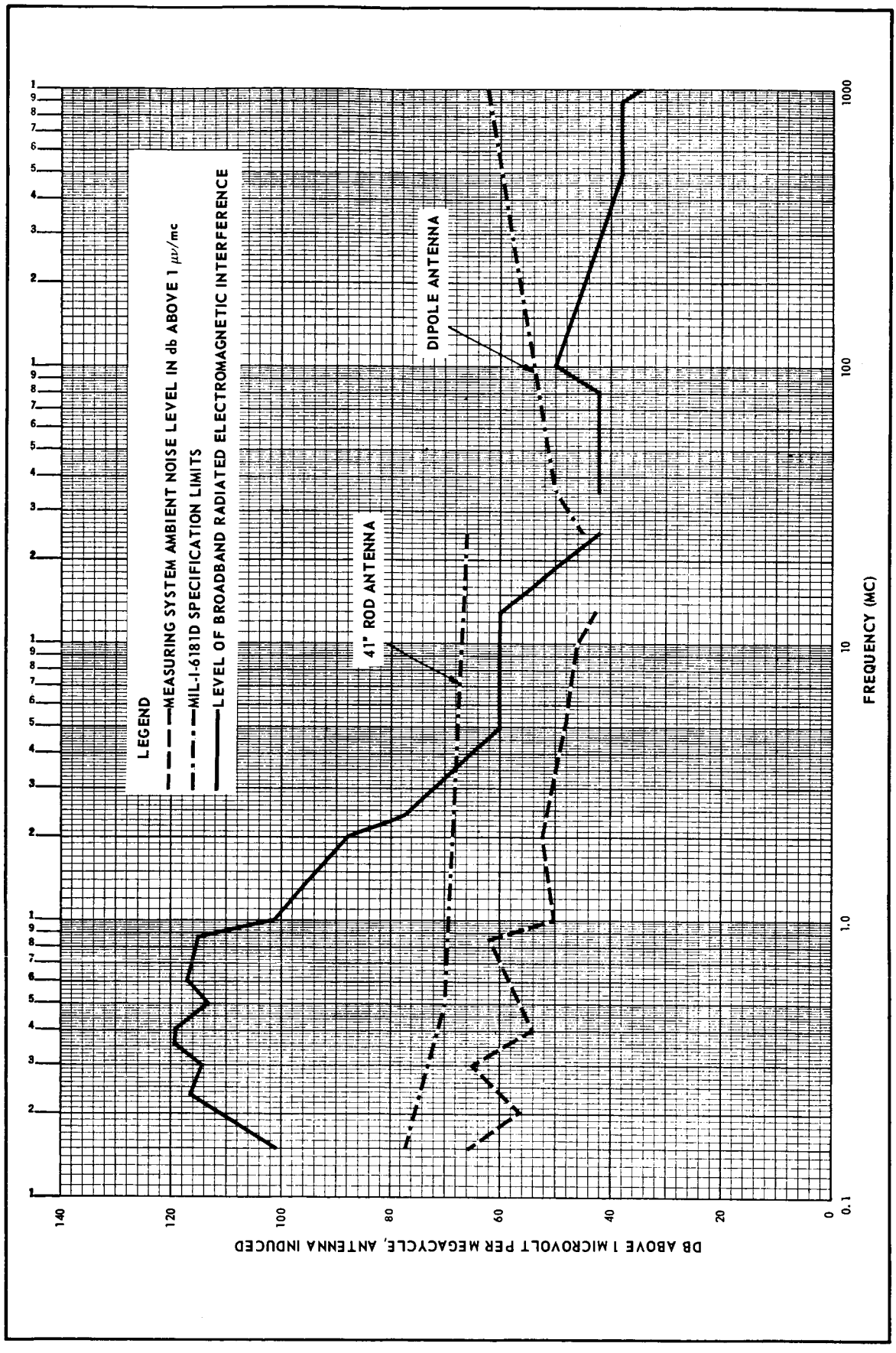

FIGURE 6. BROADBAND RADIATED INTERFERENCE TEST RESULTS (SPECIMEN C)

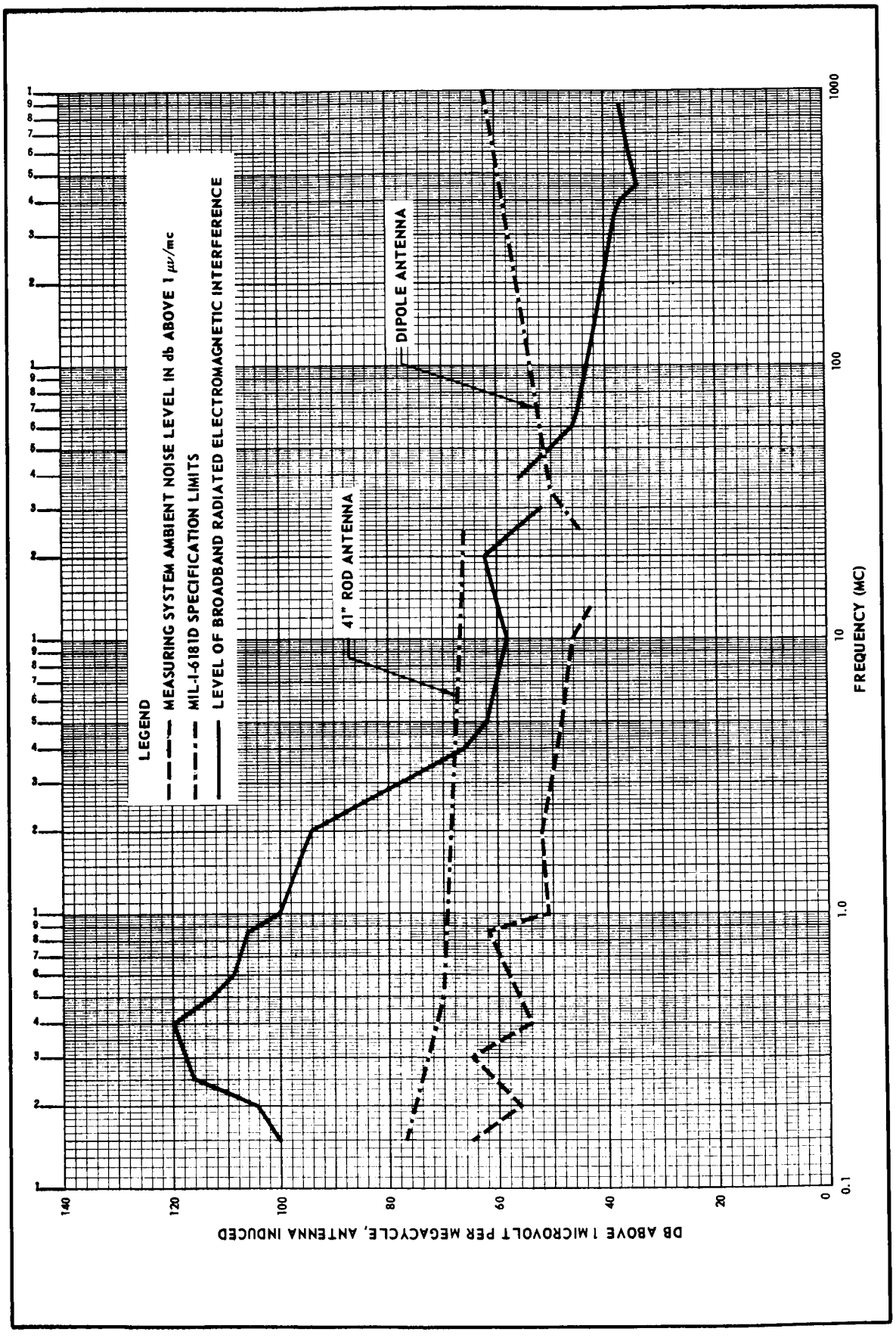

FIGURE 7. BROADBAND RADIATED INTERFERENCE TEST RESULTS (SPECIMENS A, B, AND C)

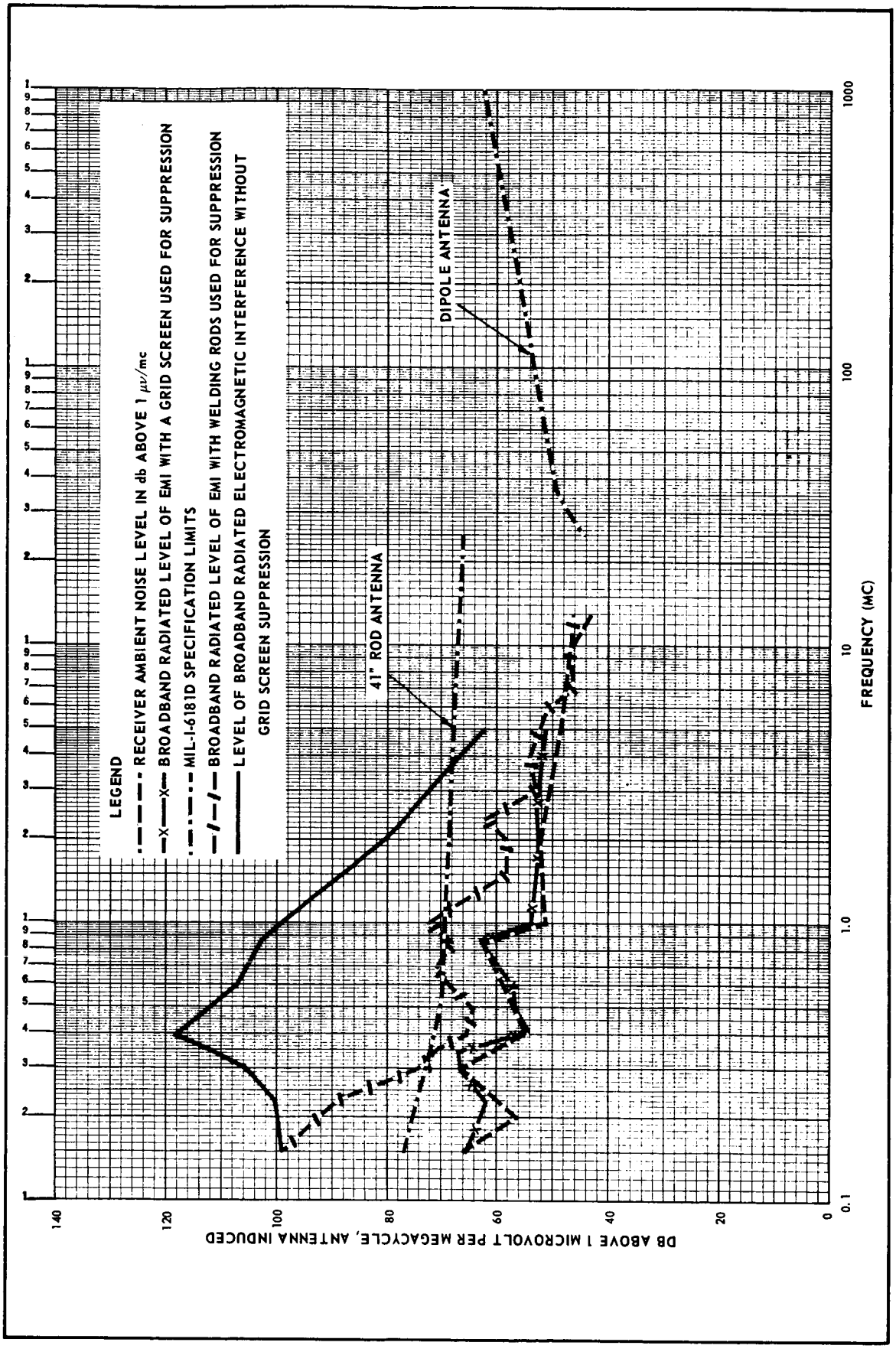

FIGURE 8. BROADBAND RADIATED INTERFERENCE TEST RESULTS (SPECIMEN C WITH GRID SCREEN AND WELDING ROD SUPPRESSION)

D. BROADBAND CONDUCTED INTERFERENCE TESTS (150 KC TO 25 MC)

Broadband conducted interference tests were performed in accordance with Military Specification MIL-I-6181D which establishes tests to be performed from 150 kc to 25 Mc.

1. Test Procedures. Tests were performed individually on three test specimens (fluorescent work lamps) and with all three test specimens connected in parallel and operating simultaneously.

Sprague line impedance stabilization networks with 50-ohm coaxial terminations were connected in series with 115-volt ac power lines. The cases of the line impedance stabilization networks were connected to the test room ground.

Figures 9 and 10 illustrate typical test configurations for measuring broadband conducted interference.

2. Test Results. The broadband conducted interference levels measured on the power lines to the individual specimens were below the limits specified by Military Specification MIL-I-6181D. When the three specimens were operated simultaneously, the measured level of broadband conducted interference was also below the specification limit but the peak level increased by 11 db above the highest level of a single test specimen.

Measurements were made to 100 Mc for future comparative studies even though the specification limits terminate at 25 Mc.

The measured levels of broadband conducted interference are presented graphically in figures 11 through 14.

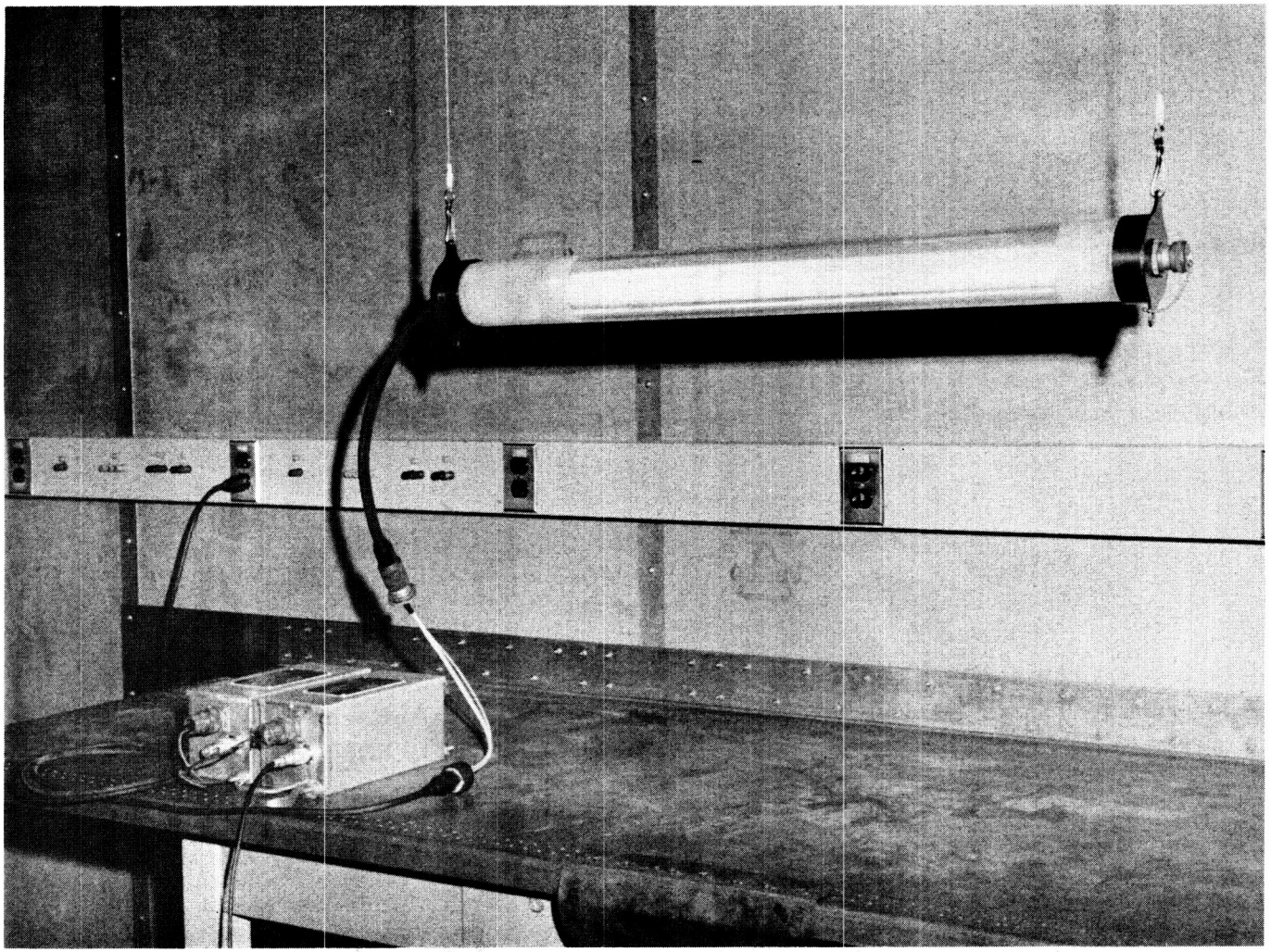

FIGURE 9. BROADBAND CONDUCTED INTERFERENCE TEST CONFIGURATION (FREQUENCY RANGE: 150KC to 100MC)

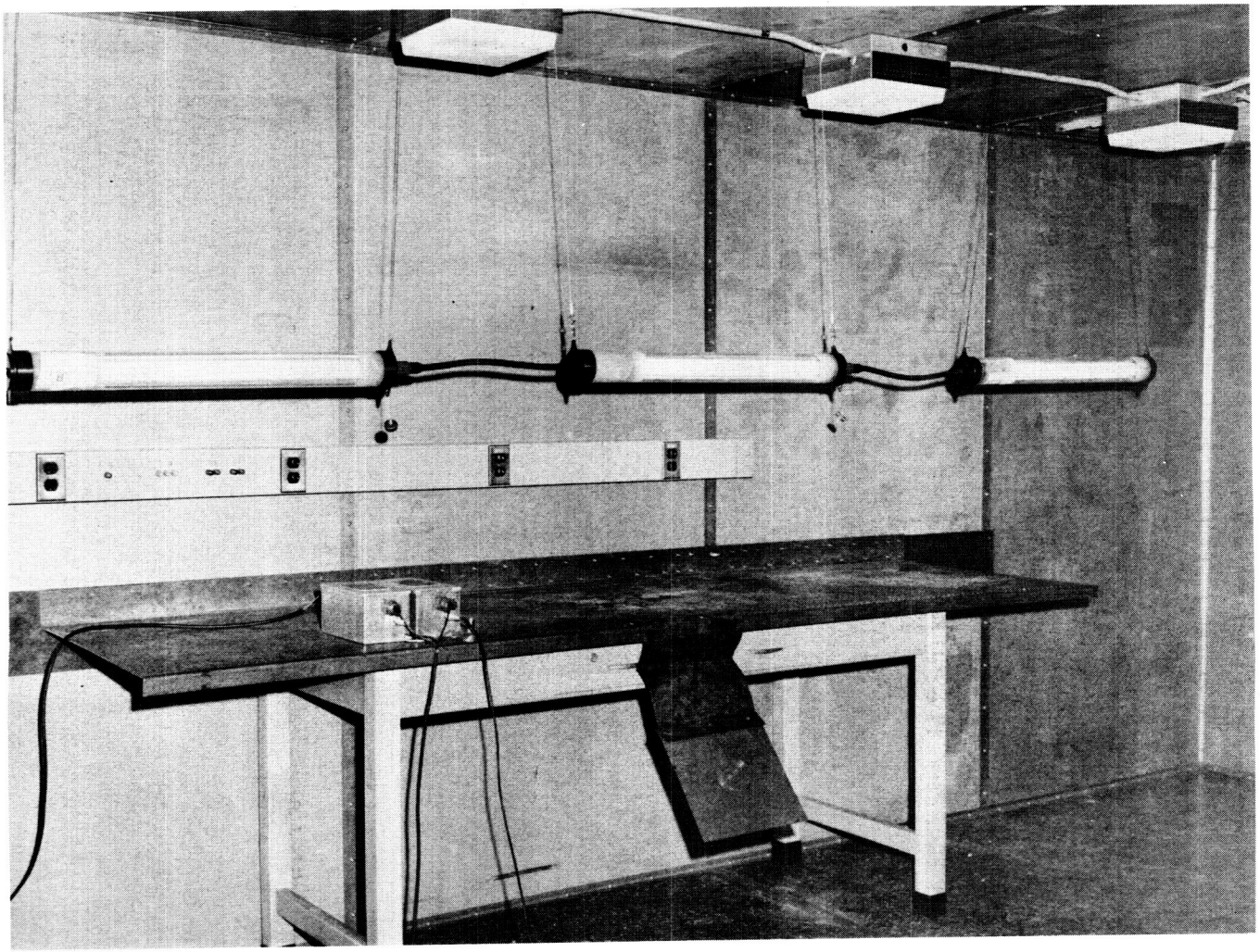

FIGURE 10. BROADBAND CONDUCTED INTERFERENCE TEST CONFIGURATION (3 SPECIMENS CONNECTED IN PARALLEL, FREQUENCY RANGE: 150KC to 100MC)

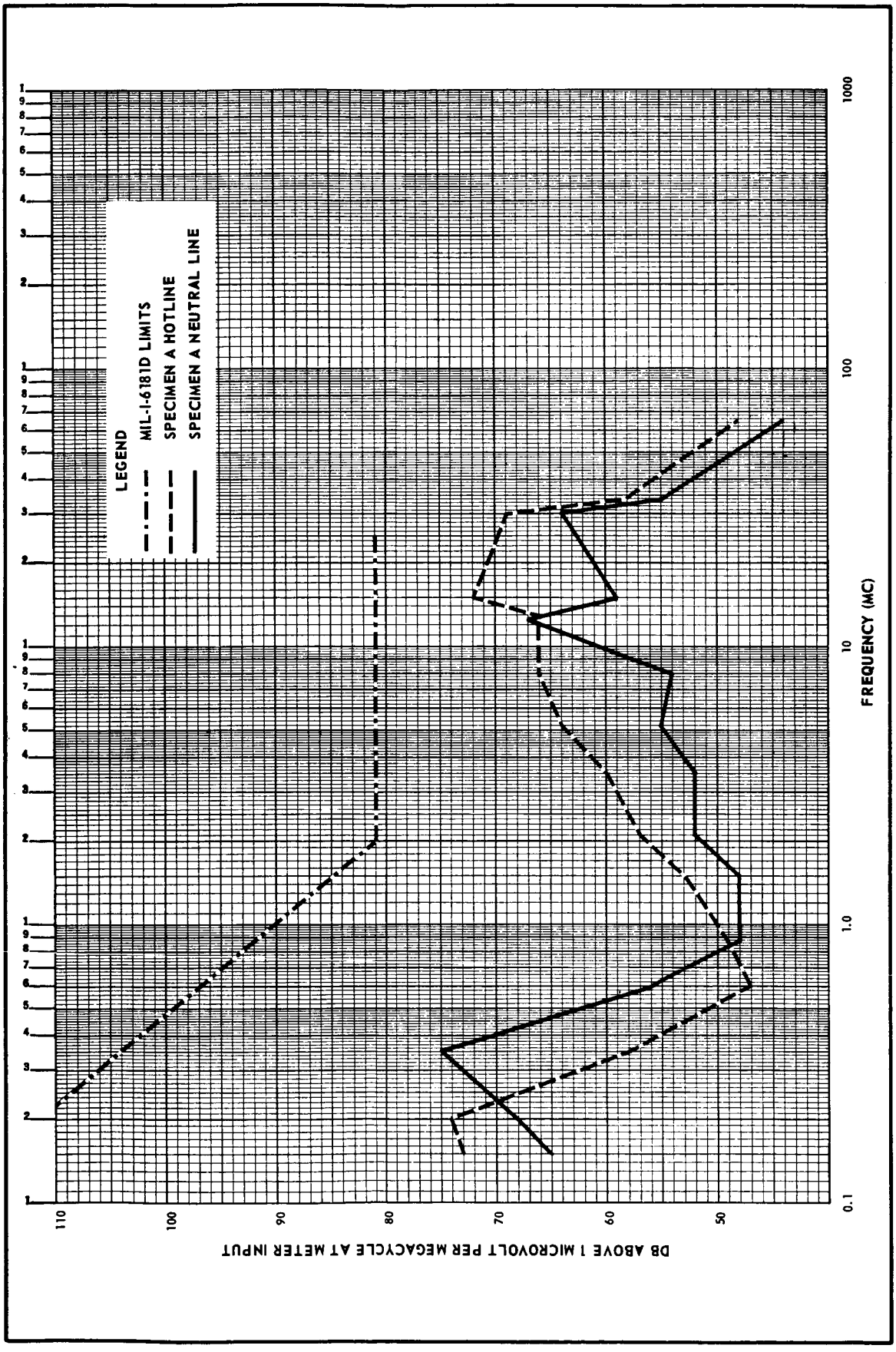

FIGURE 11. BROADBAND CONDUCTED INTERFERENCE TEST RESULTS (SPECIMEN A)

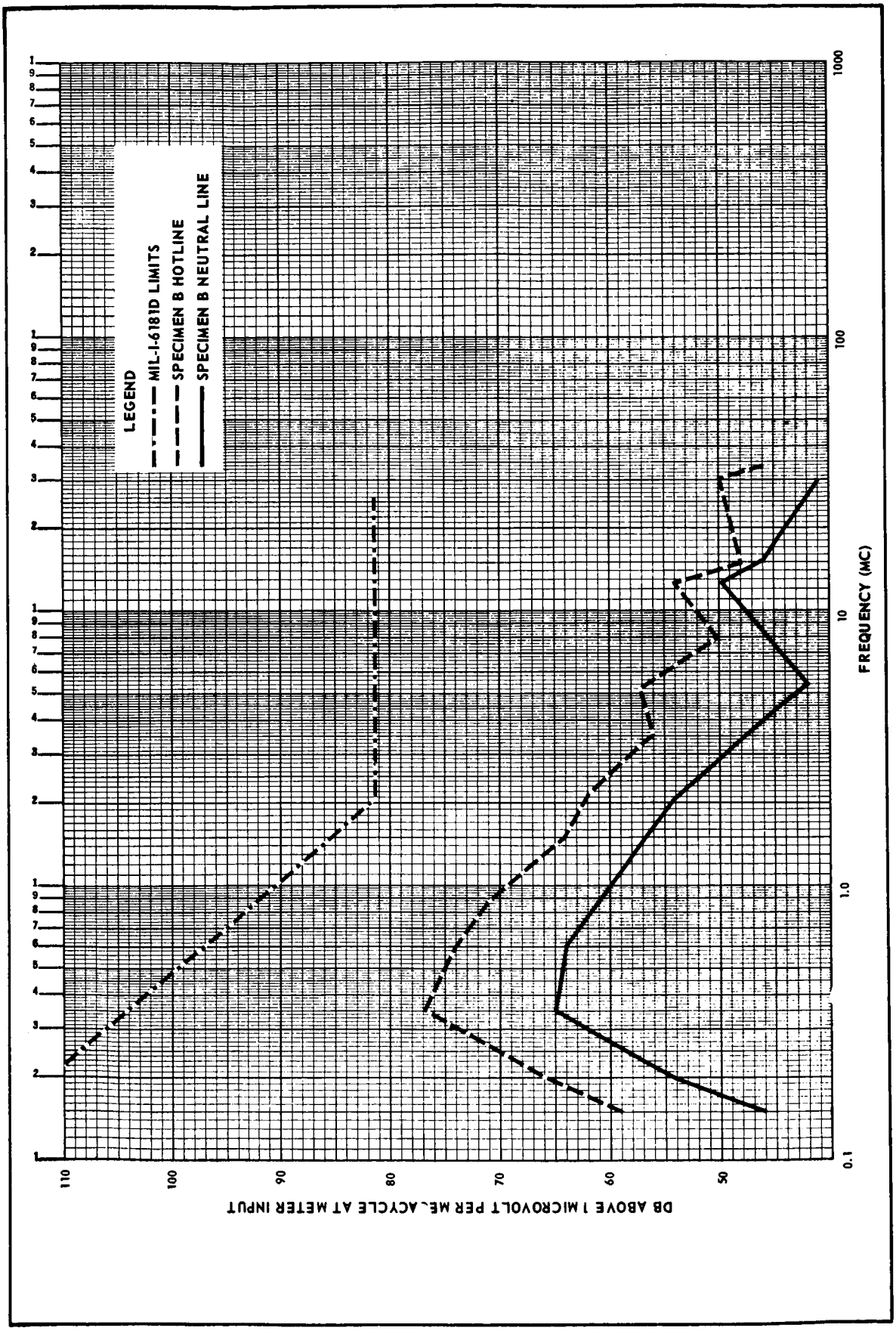

FIGURE 12. BROADBAND CONDUCTED INTERFERENCE TEST RESULTS (SPECIMEN B)

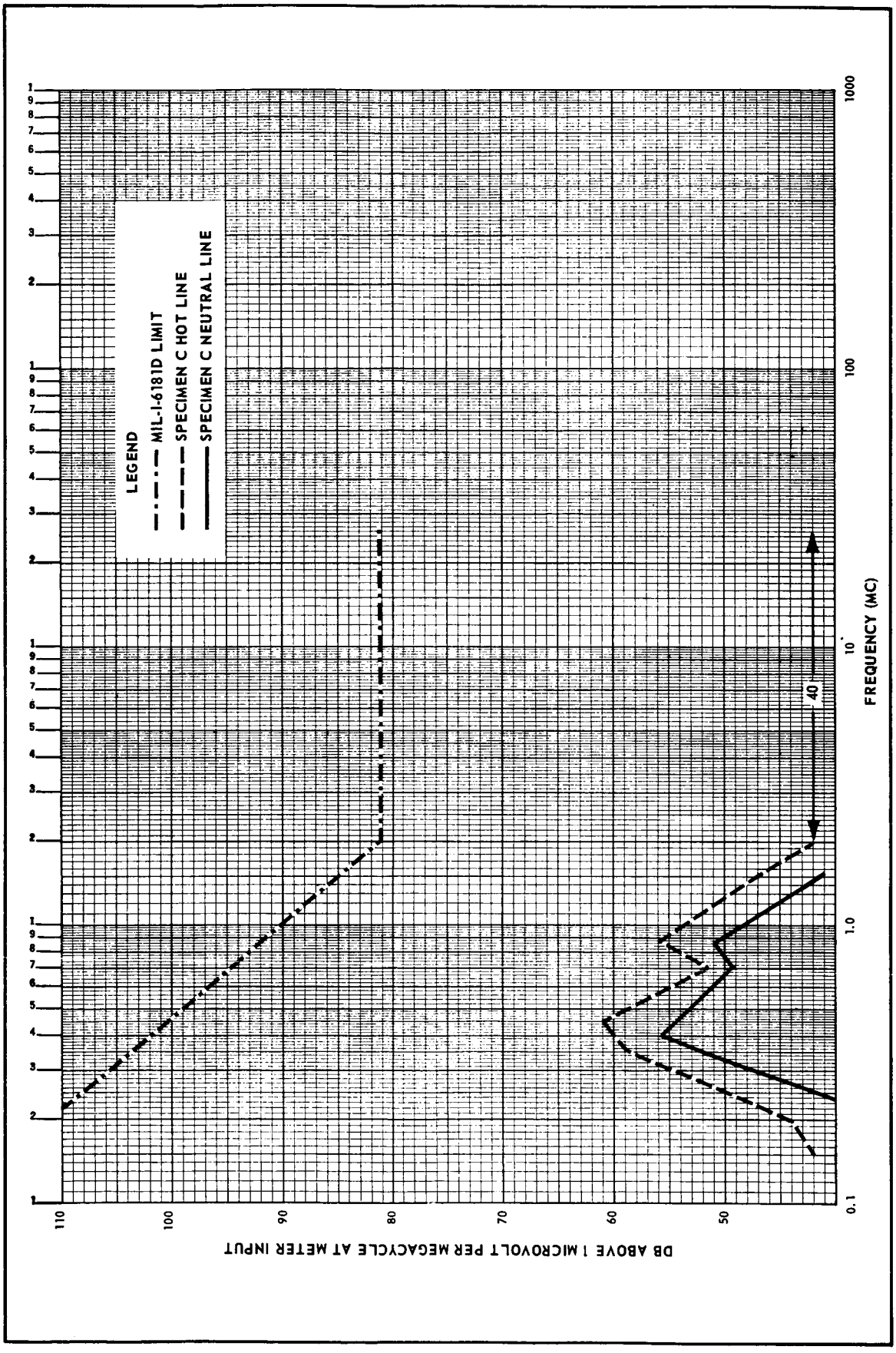

FIGURE 13. BROADBAND CONDUCTED INTERFERENCE TEST RESULTS (SPECIMEN C)

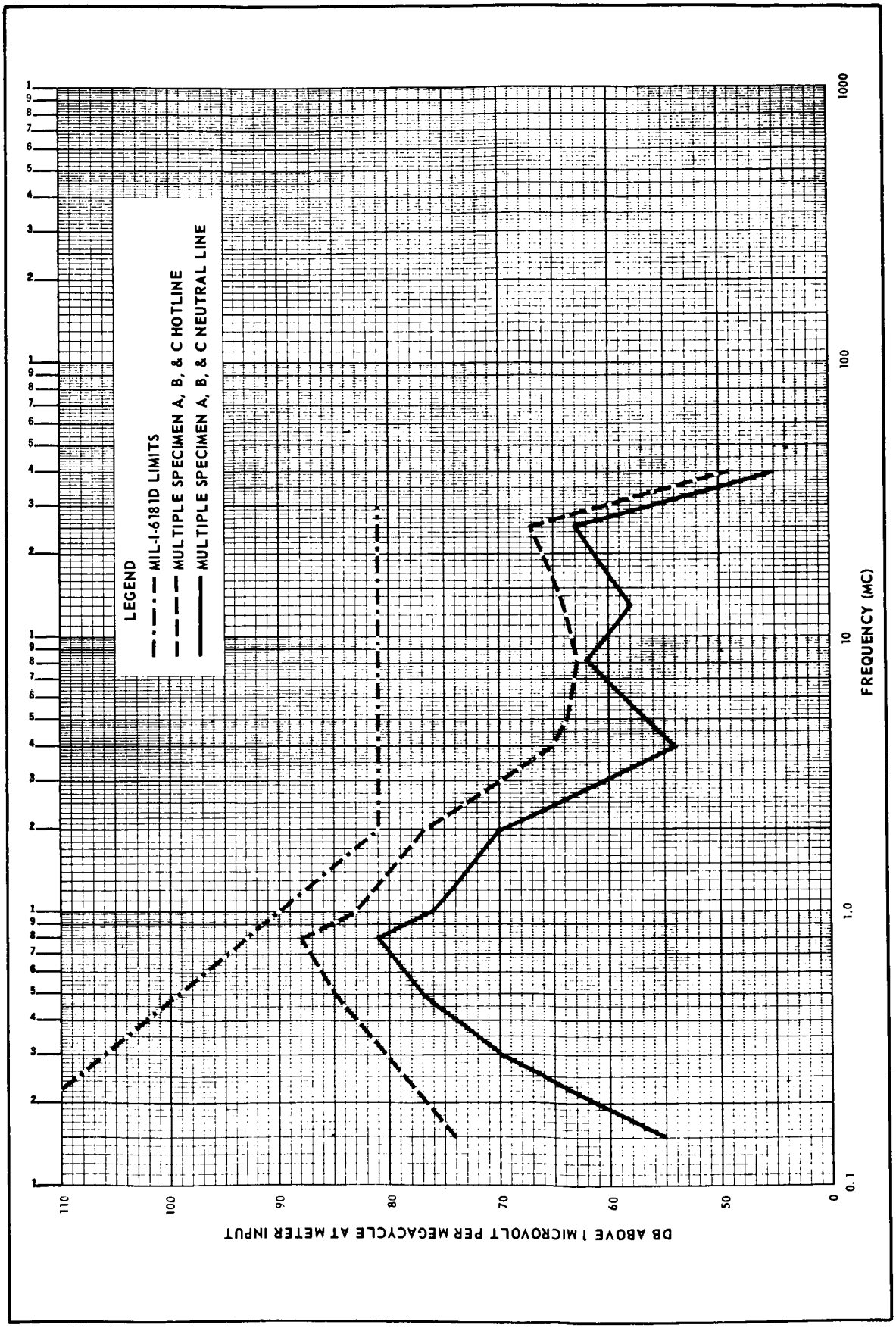

FIGURE 14. BROADBAND CONDUCTED INTERFERENCE TEST RESULTS (SPECIMENS A, B, AND C)

SECTION III
CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

1. The measured broadband radiated interference levels exceeded the limits of Military Specification MIL-I-6181D for all test specimens and test configurations.

2. Application of a fine-mesh copper screen (252 openings per square inch) over the lamp (screen grounded to the lamp at both ends) reduced interference levels to the ambient level in the shielded room.

3. A shield consisting of three welding rods running along the length of the lamp, equally spaced and grounded at both ends, reduced the peak interference level but certain frequencies still exceeded specification limits.

4. The measured levels of broadband conducted interference were below permissible limits. When three lamps were operated at the same time, the peak interference level increased by 11 db, indicating that the interference levels from the various lamps are additive.

B. RECOMMENDATIONS

1. Enclose the work lamps in a metallic grid enclosure with openings less than one-quarter square inch. This grid size was determined to be adequate from subsequent testing.

2. Electrically bond the metallic grid to each end of the work lamp to achieve a low impedance path between the shielding grid and the metal plates of the work lamp.

3. All interconnecting cables between lamps and power source should be shielded.

4. Install power line filters in the feed line to the lamps. A suitable filter would utilize two Filtron RF Interference Filters Model 5P-268 or equivalent.

5. A prototype work lamp incorporating the above suppression techniques should be constructed and submitted for additional RFI testing.

APPROVAL

TR-221

INTERFERENCE FROM SATURN V
PROTOTYPE INTERNAL WORK LIGHTS

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